Uranium isotope ratios as a tool to identify the sources of polluted sediments from Santa Rosalía copper mining region, Mexico

E. SHUMILIN[1], J.P BERNAL-URUCHURTU[2] AND K. CHOUMILINE[3]

[1]Centro Interdisciplinario de Ciencias Marinas - Instituto Politécnico Nacional, La Paz, B.C.S., Mexico, 23096 (*correspondence: eshumili@ipn.mx)
[2]Universidad Nacional Autonoma de Mexico, Mexico, D.F., Mexico, 04510 (jpbernal@unam.mx)
[3]University of California Riverside, Riverside, CA, 92521 (constan_ayanami@hotmail.com)

Uranium isotope ratios are a relatively novel and powerful tool with strong potential as a tracer/proxy of various natural and anthropogenic processes. Some of its prospective uses became possible with MC-ICPMS and range from uncovering the extent of past anoxia/euxinia registered in sedimentary rocks to tracking mineral weathering processes. Here we discuss the use of U isotopes as a way of localizing the source of polluted sediments, product of mining activities. The case study of Santa Rosalia copper mining region (Baja California Sur, Mexico) presented here focuses on a strongly polluted with Co, Cu, Mn, U and Zn coastal marine environment. Copper minerals, smelting wastes, beach and marine sediments were collected in 2011 and analyzed for $^{238}U/^{235}U$ and $^{234}U/^{238}U$ ratios. Some of the results indicate a large variability in U isotopic composition. This suggests complex physicochemical processes that produce isotopic fractionation, mainly involving the interaction between the mineralization/industrial wastes and the marine environment, probably upon contact with sea water. Values of $\varepsilon^{235}U$ (around -20) and $\delta^{234}U$ (approx. 100‰) detected for the copper mineral, were not as similar to the values from most of the clearly polluted and nonpolluted samples, with the except of two samples. One of them have a similar $\delta^{234}U$ value than the mineral mentioned above. The second one, being a marine sediment sample, displays a very negative $\delta^{234}U$ (-74‰) and peculiar $\varepsilon^{235}U$ (-11.5) value. Finally, historical data indicate that the local smelter at Santa Rosalía processed copper mineral extracted not only from the adjacent area, but also from other distant ore deposits (Sonora state, Mexico; as well as Chile). Those copper minerals might have had a distinct uranium isotopic fingerprint. This effect should not be discarded as we interpret complex systems like Santa Rosalia.